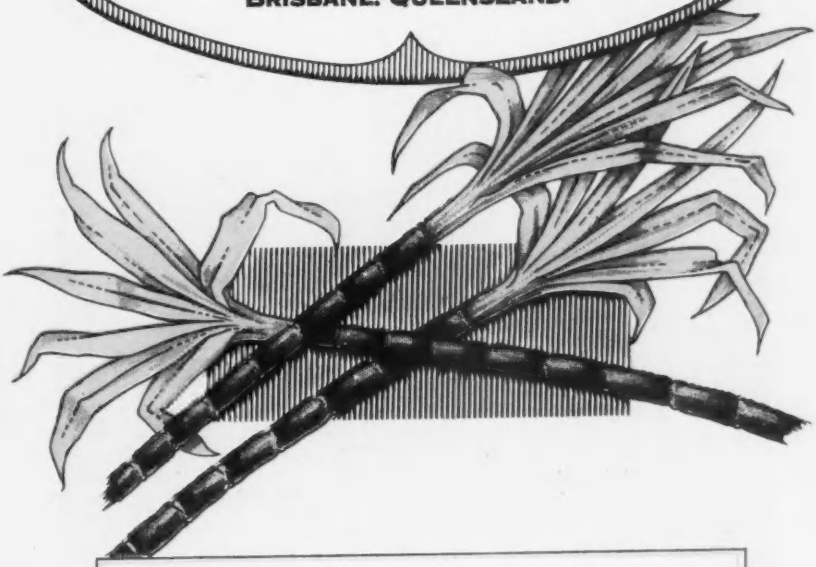
DEPARTMENT OF AGRICULTURE AND STOCK.

The CANE GROWERS' QUARTERLY BULLETIN

ISSUED BY
BUREAU OF SUGAR EXPERIMENT STATIONS
BRISBANE. QUEENSLAND.



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BUREAU OF SUGAR EXPERIMENT STATIONS
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ISSUED BY DIRECTION OF THE
HON. F. W. BULCOCK, MINISTER
FOR AGRICULTURE AND STOCK

1 JULY, 1935

DAVID WHYTE, GOVERNMENT PRINTER, BRISBANE

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The
Cane Growers' Quarterly
—Bulletin—

VOL. III 1 JULY, 1935 No. 1

Fiji Disease in the Southern Districts.

By ARTHUR F. BELL.

IT is a well-known slogan in advertising circles that "Repetition is Reputation," and it is our earnest hope that by repeated warnings we may convince growers that the reputation of Fiji disease is very unsavoury, and that no time should be lost in grappling with this menace to successful cane culture.

At the present time, Fiji disease is generally distributed throughout the Beenleigh and Maryborough districts, although the amount of infection is much the greater in the latter district. It is disconcerting to find, from a recent survey, however, that the disease has now spread from the Maryborough district into the hitherto free areas of Yerra and Pialba. The disease also exists on scattered farms in the Moreton district (where a survey is now being carried out) and the Bundaberg district. The chief centres affected at Bundaberg are Bingera and the Kalkie quarantine area; the position in the latter area has improved somewhat, but the good growing conditions of last season favoured spread of the disease, and efforts in the direction of cleaning up the disease were not as successful as they would have been in a normal season.

When the amount of Fiji disease is small (as it is in the Bundaberg and Moreton districts) it is an easily controllable disease if a reasonable amount of care is exercised. The danger lies in letting matters slip until the disease becomes widespread, when the use of resistant varieties will be the only means of defence. The situation in Beenleigh and Maryborough long ago reached this latter stage, but in the other districts there is time to reduce the disease to negligible proportions, but it must again be emphasised that no time is to be lost in effecting this clean-up.

There are probably now no lingering doubts in the minds of southern farmers that P.O.J. 2878, P.O.J. 2725, and Co. 290 will greatly outyield the old standard varieties. From our limited experience it would appear that Co. 290 is only moderately susceptible to the Fiji disease, but disease resistance trials and extensive field experience in Queensland, New South Wales, Fiji, and the Philippine Islands demonstrate beyond all doubt that the high numbered P.O.J. canes are highly susceptible to this disease. It is much more difficult to control Fiji disease in P.O.J. 2878 and P.O.J. 2725 than it is in the case of 1900 Seedling, for example, and hence the urgent necessity for stamping out the disease before these varieties can be grown with safety. For this reason, also, it would be more than foolish to approve of the planting of such canes in Maryborough and Beenleigh.

No cane is known to be immune or even very highly resistant to Fiji disease; the varieties P.O.J. 213 and P.O.J. 234 are among the most highly resistant known, and their testing out in bad Fiji areas is desirable. There are also two other P.O.J. canes which are worthy of further trial, and they will be planted in experimental plots at Maryborough this year.

Fiji disease is spread by the sugar cane leaf-hopper. This insect is present in vast numbers after the winter, and as a rule it does not multiply greatly until mid-summer. Obviously, therefore, repeated field inspections should be made and all diseased stools of cane dug out before the end of November—that is before the hopper has increased greatly in numbers. The numbers of hoppers present are usually proportional to the vigor of the crop, and consequently Fiji disease spreads more rapidly and is harder to control under irrigated conditions or in rich river-flat lands.

FIG. 1.—Leaf galls of varying size, with one greatly elongated gall on the midrib. These galls occur on the under surface of the leaves and are the outstanding characteristic of Fiji Disease.

Cane does not show symptoms of the disease until some time after it has become infected; in fact, cane infected in the autumn does not as a rule show any symptoms until some six months later. Indeed, we have had cases where symptoms have not appeared until fourteen months after the cane became infected! It will be appreciated, therefore, that apparently healthy cane is frequently diseased, and it is impossible to select healthy cane when there is much disease in the field. In any case, when the disease is present, it is safer to obtain plants from an outside disease-free source.

For the benefit of any farmers who may not be familiar with the disease, three photographs of diseased cane are included. The first symptoms to appear are small yellowish galls in the under surface of

FIG. 2.—Stiff, stunted, and malformed leaves typical of a well-advanced stage of secondary infection. The general appearance is suggestive of the upper portion of the leaves having been bitten off by some animal. Variety E.K.1.

the leaf. These galls are usually about $\frac{1}{16}$ inch in diameter, ranging from $\frac{1}{8}$-inch to 2 inches in length, and are formed by an enlargement of the veins of the leaf. (See Fig. 1.) Soon after the appearance of such galls the newly formed leaves develop a stiff appearance and soon the cane top becomes deformed and gives the impression of having been bitten off by some animal. In later stages, the leaves become somewhat ragged and tend to turn inwards (see Fig. 2). Finally, the stalk dies. When diseased setts are planted no millable cane is produced, and, as a rule, the resultant stool consists merely of a cluster of grass-like shoots which bear the typical galls in the under surface of the leaves (see Fig. 3).

FIG. 3.—The two small grass-like stools in the foreground are the result of ratooning diseased stools. The planting of infected cuttings yields a similar type of plant. Variety P.O.J.2714, 9 months old.

Although the other symptoms of Fiji disease may be confused with abnormalities due to other causes, the small galls are peculiar to this disease, and their presence removes all doubt as to the identity of the disease.

Gumming Disease in North Queensland.

By H. W. KERR.

DURING the 1934 crushing season gum was discovered in certain canes from the Aloomba area on their arrival at Mulgrave mill. The matter was reported to the Bureau, and an intensive inspection of fields in the infected area was carried out. This disease is a most serious one wherever canes are grown which are susceptible to the disease, and this is unfortunately the case in North Queensland. Two major varieties in particular are highly susceptible, S.J. 4 and Clark's Seedling. The loss of these canes through this cause would rapidly follow an extension of the disease-infected area, and this would be a most serious matter for all growers concerned.

The only method by which the disease may be contolled and eventually stamped out is to quarantine the area of infection, and prohibit the growing therein of these highly susceptible canes. Now it is not sufficient to restrict those blocks known to carry the disease. Experience teaches that one cannot state with certainty that any field of susceptible cane within a mile of gum-infected cane is disease free, and in declaring the area it was necessary to provide for this emergency.

The work of inspection was seriously handicapped by the dry conditions of the past summer. The spread of the disease and the presence of readily recognisable symptoms are favoured by wet conditions, and these were absent during the major portion of the growing season. Symptoms are now quite readily found, in the form of characteristic streaks in the cane leaves. The delayed development of these symptoms was responsible for the delay in declaring the boundaries of the quarantine area, and many growers affected by the restrictions were preparing to plant their fields with S.J. 4 or Clark's Seedling when the quarantine was declared. It is regretted that this could not be avoided, but it is hoped that the growers concerned will clearly appreciate the difficulties which were responsible for it.

Certain growers in the area will, therefore, be handicapped by the regulations, and will claim that as gumming disease does not at present exist on their farms they are being unduly penalised. We would appeal to them to look upon this emergency restriction as one demanded by the gravity of the situation. Failure to confine the disease within the restricted area where it now exists would mean great losses to all growers, particularly in the Mulgrave and Hambledon areas, where the two susceptible canes—S.J. 4 and Clark's Seedling—are of considerable importance. We recognise S.J. 4 as the most gum-susceptible cane at present cultivated in Queensland, and we would be forced to exclude completely any planting of this cane should the infection get out of hand. Further, the restrictions will be retained no longer than is necessary to ensure that all diseased canes have been eliminated from the area.

To those growers who are not acquainted with the damage which gumming disease can effect, we would instance the case of the Bundaberg area, where the industry has been almost completely wiped out by this malady on two or three occasions. At the present time farmers in those parts have a wide selection of highly resistant canes from which to select their varieties, and this has been in a large measure responsible for the marked improvement in results recorded during recent years. Unfortunately, most of these canes are not suited to northern conditions.

One variety does, however, appear to possess promise: this is known as P.O.J. 2725, and is closely related to the Java "Wonder Cane," though it differs from it in many important particulars. It is not susceptible to top rot or other major diseases of North Queensland, and it appears to be rather early maturing. It is definitely one of the strongest ratooning canes at present cultivated. All available stocks of this cane in the Cairns district will be planted out in the quarantine area during the present planting season, and if it lives up to its early promise, 30 or 40 tons of plants will be available in 1936.

The difficulties which the plant breeder meets in his efforts to produce superior yielding canes are greatly magnified by the necessity for combining with these the virtue of disease resistance. The necessarily slow process is thus still further delayed; but the Bureau is appreciative of the necessity for a rapid expansion in the project of seedling production, and with the present development of the new Meringa Station this will be possible. Meantime, only by careful attention to the quality of standard varieties, and to their freedom from disease, may they be propagated successfully.

In conclusion, it should be stressed that no grower should attempt to remove any canes whatsoever from the limits of the prescribed quarantine area unless by the permisison of an officer of the Bureau, while those growers in the quarantine area are not permitted in any circumstances to make further plantings of either S.J. 4 or Clark's Seedling.

Muriate or Sulphate of Potash?

The question is frequently asked: "Is sulphate of potash superior to muriate of potash for sugar cane fertilization?" Only a few years ago it was generally agreed that the muriate was the inferior form of this plantfood, and probably as a consequence, the muriate could be purchased at a much more attractive price. There appears to be definite evidence that for certain crops—notably tobacco—sulphate of potash is to be preferred; but little was known as regards the behaviour of these respective salts with sugar cane.

Several experiments to test this point have been conducted on our Experiment Stations, and in all cases muriate and sulphate of potash were equally valuable. The Bureau, therefore, recommends at all times the use of the less expensive form—muriate. It will be observed that muriate of potash is prescribed exclusively for the entire range of Sugar Bureau fertilizer mixtures.

Muriate does possess the disagreeable property of "setting" in the bags if stored under humid atmospheric conditions. This objection is satisfactorily overcome, in the case of mixed fertilizers, by providing a reasonable admixture of meatworks manure which serves the purpose of a conditioner, and preserves the mixture in a satisfactory physical state.

H.W.K.

Subsidy on Fertilizers.

It has been announced by the Federal Government that the subsidy to primary producers of 15s. per ton on artificial manures, used in the production of products other than wheat, will be continued for twelve months as from 1st July, 1935.

P.O.J. Varieties in Mackay District.

A Warning to Canegrowers.

By H. W. KERR.

DURING the past season in the Mackay district certain of the mills reported difficulty in treating the juice from the P.O.J. canes—2714 and 2878—and manufacturing therefrom good quality sugar. The difficulty apparently lay in the failure of the muds to separate from the juice, and black cloudy juice passed from the subsiders when a high proportion of these canes was being treated. Similar conditions have been reported in the past from those overseas countries where appreciable proportions of these varieties are grown. The modifications in mill practice which would be necessary before these refractory juices could be dealt with successfully, would definitely increase the costs of manufacture, and the mills claim that any such penalty should be borne by the grower.

The Bureau has been drawn in to adjudicate in this discussion, and it has been agreed to follow closely the influence of the P.O.J. canes on manufacture during the 1935 crushing season. Should the conditions of 1934 be experienced again, growers may expect a stout protest from the mills in those parts. With this possibility in view, we therefore hasten to warn growers against wholesale plantings of these varieties during the present season. Rather would we urge a definite moderation of plans if such were contemplated.

Quite apart from the increased costs of manufacture which refractory juices entail, it must be remembered by the grower that anything which tends to slow up the work of the mill prolongs the harvesting season, and to this extent is detrimental to the interests of the farmer. We therefore ask that due notice be taken of this warning, and urge growers to co-operate in an endeavour to avoid anything which might have disagreeable consequences for miller and grower alike.

Green Manure for Alluvial Soils.

The value of green manuring has become widely recognised by Queensland canegrowers. There are, however, large numbers of growers who adhere to the practice of bare fallowing between final ratoons and plant crops. Such growers will argue that the spell thus given to the soil is more efficacious than the growing and ploughing in of a green cover crop.

The disadvantages of the bare fallow are that unrestricted growth of weeds and grass takes place unless the land is kept continually cultivated, and that the wet season rains promote scouring and erosion of the loose surface soil. If, on the other hand, a green manure crop is sown, say in November or December, a good heavy cover crop is established when the normal wet season occurs. Soil erosion is at a minimum, and the beating action of the rain on the soil is prevented. In addition to this the soil-building and humus-producing qualities of a green manure crop cannot be ignored. A medium-sized Poona pea crop is about 10 tons per acre—obtained by the expenditure of three or four shillings on seed. The rotting of this crop in the soil brings about an improvement in

physical condition and moisture retaining capacity and assists in the recovery of those ideal conditions which obtained in the virgin soil. A 10-ton crop of green manure contains the equivalent of approximately 750 lb. per acre of sulphate of ammonia, and no canegrower can afford to disregard this addition to the productivity of his soil.

It is a well-known fact in the Bundaberg district that, although green manuring is practised extensively on the red volcanic and red forest soils, the farmer who green manures on the river alluvial country is the exception rather than the rule. The reason for this is difficult to understand. Conditions on these river alluvial soils are more favourable for green fallowing than on the red soils. An abundance of moisture is generally available in summer and early autumn so that a heavy crop is assured. Another point in favour of these soils is that, being generally frosted, all planting is carried out in the spring, so that two green crops could be grown between October and April, the first being allowed to seed before turning in. When one considers that the alluvial soils are probably the most highly deficient in nitrogen in the Bundaberg area the failure to sow green crops becomes more serious. The rapid grass and weed growth on these lands during fallow would also be minimised by having a cover crop on the land.

N.J.K.

Dirty Headlands.

Field surroundings are often dangerously neglected. It is not uncommon in certain areas to find long, dead grass extending without a break from railroad or road to the adjacent maturing cane, and one can only be surprised at the infrequency of disastrous cane fires where such conditions exist. A live coal from the ashpan of a passing locomotive or any ejected spark might easily be the cause of considerable loss to the grower. Grassy headlands frequently harbour noxious pests and diseases, and as such are a menace also; while wind and irrigation water carry the seeds to the cultivated area.

The slight proportion of rat damage to cane in the Burdekin area could be almost entirely avoided if the delinquent growers would pay a little more attention to these harbourages. Early firing of the dry grass after the crop has been harvested, and the timely use of the disc harrows provide a simple solution of the problem. Where implements cannot be used, as along some irrigation drains, poison sprays are effective. Clean headlands mean clean fields, while nothing looks more untidy than a grassy headland surrounding a 60-ton crop of cane.

A.P.G.

Clustered Stool.

The accompanying photograph illustrates a malformed condition of the cane stool which is known as "clustered stool." This condition is not a disease in the true sense, inasmuch as it is not caused by a parasite, but is one of the peculiar "sports" which occur in most plants from time to time. It is much more common in varieties of cane which have been bred up from the "wild" type such as P.O.J. 2878 and other high numbered P.O.J. canes.

During the past season several specimens have been forwarded to the pathology laboratory for diagnosis on account of the resemblance to Fiji disease. Undoubtedly such stools bear a general resemblance to stools which result from the planting of Fiji diseased setts, but the presence or absence of this disease can always be determined with certainty by an examination of the lower surfaces of the leaves. If Fiji disease is present small yellowish galls (possibly only one or two per leaf) of about $\frac{1}{16}$ inch in diameter, and generally $\frac{1}{4}$ to $\frac{1}{2}$ inch long, will be found on the underside of the larger veins of the leaves.

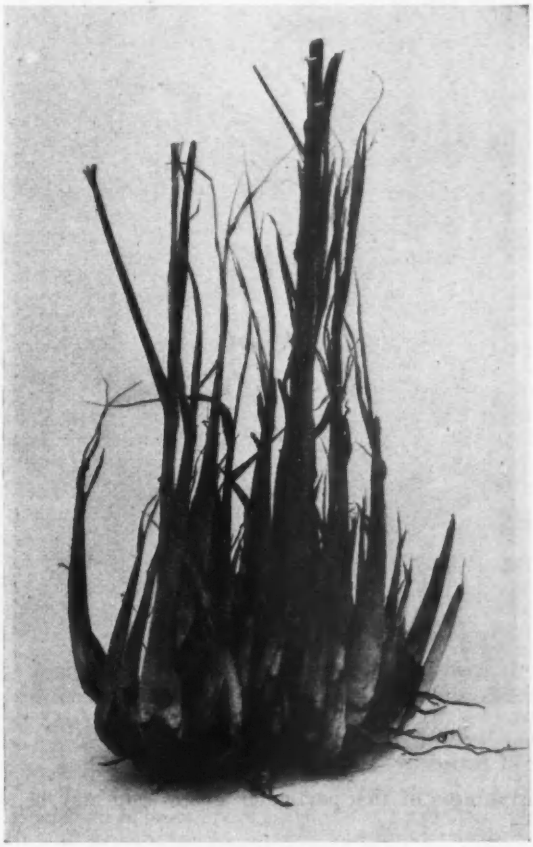

FIG. 4.—Illustrating "Clustered Stool" in P.O.J. 2878.

The photograph shows a small stool of P.O.J. 2878 in which sixty-five shoots had developed. This malformation is probably allied to stem gall, another peculiarity common to P.O.J. 2878. There need be no belief, however, that either of these troubles is infectious.

A.F.B.

Poona Pea as a Green Manure.

The use of Poona pea as a green manure is rapidly becoming popular in the cane areas of North Queensland. The accompanying photograph shows a splendid crop on the farm of Vessy and Sons, Edge Hill, Cairns. The soil is of a schist nature, and Poona pea is found to give better results than other green crops on this class of country.

FIG. 5.—An Excellent Crop of Poona Pea at Edge Hill, Cairns.

The advantages of this particular green crop may be summarised as follows:—

1. Quick and certain germination;
2. More succulent than Mauritius beans, and consequently easier to plough under;
3. More resistant to bean fly than cowpea;
4. Gives crop under adverse conditions;
5. Higher value in supplying nitrogen than other crops;
6. Cheap to grow; seed costs 12s. 6d. to 17s. 6d. a bushel, which will take care of at least four acres.

Most farmers during the past season made the mistake of planting too thickly. From 12 to 15 lb. per acre are recommended, but as the seed is very small, care must be taken in broadcasting, otherwise this amount will be exceeded.

Up to the present the chief disadvantage shown by Poona pea is its tendency to come to maturity too quickly, especially when planted in rich soil. Further, if allowed to mature seed before ploughing under, subsequent germination may be troublesome to control after the young cane has been planted. It is, however, not nearly so difficult in this respect as Mauritius bean.

G.B.

B. 208 and Downy Mildew Disease.

BY H. W. KERR.

THE variety B. 208 is one of the sweetest canes grown in Queensland. It is at the same time one of the most highly susceptible to practically all major cane diseases. For this reason chiefly its culture has been restricted almost exclusively to the Burdekin area, where excellent crops of high C.C.S. value are harvested annually.

In this district the major disease is Downy Mildew, and its effects are confined almost exclusively to B. 208. Moreover, the disease is so widespread that it cannot be stated with certainty that any field of B. 208 in the Burdekin is disease-free. Some years ago it was thought that only by the complete elimination of this variety could downy mildew be eradicated. Such drastic steps were to be considered only as a last resource, and even then only when suitable alternative varieties were available to take its place. Attempts were made, therefore, to hold the degree of infection within reasonable bounds by careful roguings of young plants blocks, particularly in those sections of the field where plants would be cut during the following year. The wisdom of this expedient has been demonstrated by the marked improvement which has been effected on the Ayr side where our local officer has been able to devote himself to this tedious work. But it is only a stop-gap measure which will partially control, but not eliminate the disease.

On the Home Hill side, where close inspectional work could not be effected, quite another picture is presented. Many growers during the past year have reluctantly declared their intention of "going out of" this variety due to its diseased condition. In the circumstances, it is the only wise course to pursue, and it is the intention of the Bureau to call a general meeting of Inkerman suppliers at an early date to consider the wisdom of temporarily disapproving B 208, with the object of eliminating all present stocks entirely and thus providing disease-free conditions for a re-introduction of this valuable cane in a healthy state. This could be effected over a period of no more than four years.

This conclusion has been reached only after careful consideration, and we would appreciate any criticism or endorsement of the plan which interested growers have to offer. We are encouraged in this decision by the promise shown by two alternative canes which were recently introduced to the area, and which have shown up exceedingly favourably in trials to date. They are S.J. 7—a seedling of Badila parentage

which was bred at South Johnstone some 13 years ago—and P.O.J. 2725, which was introduced from Java some six years ago, and which, unlike its close relations P.O.J. 2714 and 2878, is highly resistant to practically all major diseases, including downy mildew and top rot (red stripe). S.J. 7 is also resistant to downy mildew, though not to the same degree as P.O.J. 2725, and is not more susceptible to red stripe than Badila. Both canes have shown a high degree of growth vigour, and each is moderately early maturing under Burdekin conditions.

Some hundreds of tons of these varieties have been made available for distribution to growers in the Giru-Ayr-Home Hill areas this year. We would urge all interested growers to secure trial lots of these canes, as they appear to be the most suitable temporary substitutes for B. 208 at present offering. Growers in these areas are asked to communicate with the Secretary of the Lower Burdekin District Cane Growers' Executive if they wish to obtain supplies. It is further recommended that plantings of S.J.7 be made as far as possible from any blocks of B 208, so as to give the new variety every chance of escaping infection.

To growers in other areas who may be attracted by the enthusiastic comments offered on behalf of these new varieties, we would hasten to add that P.O.J. 2725 is at present under trial in all cane areas and an early release of stocks will be made in the far North should it come up to expectations, but S.J. 7 is destined to remain a "Burdekin variety" exclusively, at least for some time. Of all varieties at present cultivated in Queensland it is one of the most susceptible to both gumming and leaf scald disease. Indeed, it is interesting to recall that the present stocks of this cane were built up from the only disease-free stool of the cane which could be found in North Queensland in 1929. The few stools which resulted therefrom were grown under strict supervision in Brisbane until their freedom from disease was definitely established, when the crop was transferred to Ayr. It may, therefore, only be grown in areas where gumming and leaf scald do not exist—and this automatically restricts its range to the lands of the Burdekin.

Irrigation in North Queensland.

During the past summer several new irrigation plants were installed in North Queensland. Most of these were actually in operation in the Tully area, reputedly the wettest area in Queensland. In common with all other Northern cane areas an unusally long dry spell took the place of the normal wet season and the cane suffered severely. Those growers who were able to apply water to their crops during this period will reap a marked benefit in increased yields, and it is fairly safe to assume that the results which would accrue from adequate irrigation in a season such as this would be sufficient to cover the major portion of the costs of the installation.

It is not suggested that irrigation should be regarded as an economic means of producing surplus sugar. Rather is it to be considered as a means of ensuring consistent crops, and the results of the past three years show definitely that it is practically an indispensable aid to any rational crop regulation scheme.

The accompanying photographs were taken on the farm of Mr. E. Sues, of Gordonvale, who was the first grower in the far North to put in a pumping plant. It consists of a 7-in. centrifugal pump, with 9-in. delivery, driven by a 25 h.p. electric motor. It is reckoned to deliver

FIG. 6.—Showing Centrifugal Pump.

60,000 gallons of water per hour. The water is drawn from the Mulgrave River, and is of excellent quality. The water is conducted through a pipe line of reinforced concrete.

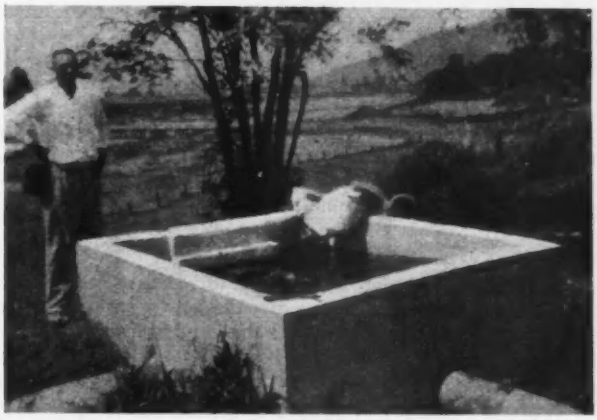

FIG. 7.—Showing Discharge Tank and Distribution Mains.

That portion of the crop which was irrigated during the dry months demonstrates in no uncertain manner the benefits of the treatment, and will cut many tons to the acre in excess of similar cane which was dependent on natural rainfall.

Feeding Farm Animals.

By H. W. Kerr.

INTRODUCTION.

At the Bundaberg Conference of the Technologists' Society a paper was read by Mr. G. E. Waddell on "Scientific Horse Feeding." An interesting discussion ensued, and it was evident that a wide diversity of opinion exists as to the feed requirements of the farm horse, and the manner in which a suitable ration may be supplied economically. At the request of several cane farmers, I have much pleasure in preparing a review of the proposals and recommendations presented by Mr. Waddell. First of all, however, it appears desirable to set out in a brief and elementary manner the fundamental principles of animal nutrition so as to provide a background for the discussion of an important subject which is all too imperfectly understood by farmers in general.

COMPOSITION OF FEEDS.

There is a very important point of distinction between the plant and the animal kingdoms. It is the function of the plant to build up carbonic acid gas, water, and the so-called plant-foods absorbed from the soil into the various complex tissues, in which process the sun's energy plays a most important part. The animal is entirely dependent, either directly or indirectly on these plant materials for its life functions. We must therefore understand the nature of plant materials, and the manner in which they are utilized in the animal body.

When the chemist analyses a feeding material, he subdivides its constituents into the following groups:—

(*a*) *Proteins*—or substances containing nitrogen;

(*b*) *Carbohydrates* embracing sugars, starches and fibre;

(*c*) *Fats*, and

(*d*) *Mineral substances* (so-called *ash*.)

These groups of substances are known as *nutrients*, and each possesses its own peculiar properties and functions when taken into the digestive system of the animal.

ANIMAL NUTRITION.

The animal body consists essentially of a bony skeleton of mineral matter—largely phosphate of lime—surrounded by an elaborate muscular system. Fatty tissues permeate the bones and muscles, and around all is the enveloping skin. Within the body cavity are the various special organs, designed for dissolving, distributing and utilizing the nutritive matter of the food and for disposing of the waste. While the composition of the plant is predominately carbohydrate in nature, the animal body is thus largely built of proteins.

The changes which the food undergoes within the digestive tract of the animal is known as *digestion*. This process prepares the nutrients for absorption and use in building new tissues, repairing those which are broken down, and as a source of energy. Carbohydrates can only be absorbed by the animal body when they have been converted into

simple sugars, and there are several digestive juices which act on the starches and more complex forms to reduce them to this simple state. Fats must be broken up during the digestive process and converted to a form in which they may be absorbed through the intestinal wall. Proteins are likewise reduced to simple, soluble compounds before they can be taken into the bloodstream and utilized; thus the relatively complex plant proteins are taken apart before they may be absorbed by the cells of the animal body and built up once again into complex animal proteins. The mineral matter is not substantially changed during digestion, but is merely brought into a soluble condition and thus absorbed.

FUNCTIONS OF THE NUTRIENTS.

The digested nutrients are transported by the circulating bloodstream for the nourishment of all parts of the body. They may then be "burned" to warm the animal—through the agency of oxygen absorbed by the lungs—or to produce energy for the performance of work. If more nutrients are supplied than are necessary for these purposes, the excess may be converted into body tissues, either protein or fat. The burning of the nutrients in the animal body produces carbonic acid gas which is eventually eliminated through the lungs; the waste nitrogenous products produced by the breaking down of protein material are excreted in the urine together with the surplus of mineral matter.

DIGESTIBILITY OF FEEDS.

Now it is found that all feeds are not of equal value to the animal, by virtue of the fact that their nutrients are but partially digestible. The indigestible portion of the feed is represented by the fœces which have really never entered the animal body. The extent to which the different nutrients are digestible has been determined as the result of a large number of feeding trials, in which the total amount of nutrient fed to the animal is compared with that which is voided in the fœces. The following list provides the results obtained from a selection of common feed materials in which the canegrower will be interested; the figures in brackets denote the percentage of digestible matter in each ingredient:—

Feeding Stuff.	Water.	Protein.	Carbohydrates.		Fat.	Dry Matter—Digestible.
			Fibre.	Sugars, Starches, etc.		
	%	%	%	%	%	%
Concentrates—						
Oats	9	12 (78)	11 (35)	60 (81)	4 (87)	70
Maize	11	10 (74)	2 (57)	71 (94)	5 (93)	90
Bran	10	16 (78)	10 (31)	54 (72)	4 (68)	65
Linseed meal ..	9	34 (89)	8 (57)	36 (78)	8 (89)	79
Molasses	25	3 (32)	Nil	60 (90)	Nil	78
Roughages—						
Oat hay	12	8 (54)	28 (52)	42 (56)	3 (61)	54
Oat straw	12	4 (28)	36 (60)	41 (51)	2 (39)	54
Lucerne hay ..	9	15 (71)	28 (43)	37 (72)	2 (38)	60
Cane tops	68	2 (54)	10 (59)	17 (75)	..	69
Young grass, 6 in.	70	5 (70)	6 (60)	14 (78)	1 (60)	..
Mature grass (Paspalum)	85	2	4	8	..	..

This list has been subdivided for convenience into two classes of feed—(*a*) *Concentrates.* which are low in fibre and contain a large proportion of digestible nutrients; and (*b*) *Roughages,* which are the coarser feeding stuffs, high in fibre and supplying a lower percentage of digestible matter. In practice it is customary to blend a proportion of each class to provide a ration which supplies bulk as well as the essential nutrients in the required proportions.

FEED REQUIREMENTS OF THE HORSE.

The following are regarded as the minimum nutrient requirements of the horse:—

Horse.	PER DAY PER 1000 LB. LIVE WEIGHT.			
	Dry Matter.	Digestible Protein.	Total Digestible Nutrients.	Nutritive Ratio.
	Lb.	Lb.	Lb.	
Idle	13–18	0·8–1·0	7–9	8·0–9·0
At light work	15–20	1·0–1·2	9–11	8·0–8·5
At medium work	16–21	1·2–1·5	11–13	7·8–8·3
At heavy work	18–22	1·5–1·8	13–15	7·6–8·1

It will be observed that the total quantity of nutrients required depends on the nature of the work which the animal is performing. Moreover, it will be seen that the "Nutritive Ratio" varies accordingly. This ratio is simply the relationship between the weights of digestible carbohydrates and fats (energy material) to digestible proteins. With increased exertion, there is also an increase in the rate at which the body tissues are broken down and a consequent heavier demand on proteins to repair these tissues.

In determining a suitable combination of feeding stuffs to provide the farm animal with its requirements, several important considerations demand attention. The horse is limited in its capacity to consume roughage, and in general some concentrate must be added to the ration to supplement the deficiencies of the coarse fodder. The nature of the concentrate added will be governed by the nature of the digestible nutrients available in the roughage. And finally, the farmer will wish to purchase those concentrates which supply the desired nutrients at the lowest unit cost. It will be observed that in these discussions the use of maize or oats, or linseed meal as concentrate is considered only in its ability to supply economically the desired nutrients and not because of any special virtue which each possesses. This is a point on which prejudice often obscures the farmer's better judgement.

A study of the list of feeding stuffs given above brings out the following interesting points:—

(1) Maize has the highest percentage of digestible nutrients of all feeds listed: 90 per cent. of the total material is actually digestible. It will be observed, however, that its nutrients are chiefly starches and fats, and it is notably deficient in proteins; in this respect it does not compare favourably with lucerne hay, which is 50 per cent. richer in this nutrient.

(2) Comparing lucerne hay* with oaten hay*, it will be seen that they are essentially equivalent in the proportion of digestible carbohydrates, but lucerne hay will supply almost twice as much digestible protein as will the oaten hay. This suggests that lucerne might well be used in preference to oaten hay, with advantage to both the farmer's pocket and the animal.

(3) Molasses is a concentrate rich in carbohydrates (sugars) and containing but a small proportion of digestible proteins.

(4) Cane tops ("chop") provide good average roughage, with but little digestible protein and fair carbohydrate value. It does not compare favourably with young pasture with respect to digestible proteins, though it is decidedly superior in every particular to mature dry grass.

(5) Linseed meal is found to be a particularly useful concentrate where it is necessary to supply substantial amounts of protein to provide a balanced ration, though it must not be used excessively. One pound per day is regarded as a suitable addition. It is also rich in digestible carbohydrates and fats.

DETERMINING THE RATION.

In calculating a satisfactory ration it is best to begin with the amounts of the several nutrients which the horse obtains from the roughage available to it. It will be evident that a horse pastured on young grass will require different supplementary feed from one fed on chop or old pasture; while a horse in full work demands an all-round increase in nutrients over that for one at light work, as shown in the table given above. Consider, for example, a 1,300 lb. horse at regular ploughing work. Suppose it consumes 8lb. of good quality young grass at night, and receives a daily ration of 8 lb. maize and 14 lb. chaff. The available nutrients in this total feed and the corresponding minimum requirements are:—

Feeding Stuffs.	Dry Matter.	Digestible Proteins.	Total Digestible Nutrients.	Nutritive Ratio.
	Lb.	Lb.	Lb.	
Maize, 8 lb.	7·2	0·6	6·9	1 to 10
Chaff, 14 lb.	12·4	0·1	6·4	1 to 45
Young grass, 8 lb.	2·4	0·3	1·6	1 to 5
Total	22·0	1·0	14·9	1 to 13
Minimum requirements	23·4	2·0	16·9	1 to 8

It is evident then, that the animal is getting too little dry matter and total digestible nutrients, while the high nutritive ratio shows that the ration contains too little digestible protein. This could be adjusted by the addition of a proportion of linseed meal and by substituting some feed richer in protein (lucerne hay) for a proportion of the maize.

* Generally spoken of as "chaff."

For a farmer who is feeding 20 lb. chop and 8 lb. molasses, and allowing his animals to graze out at night on rank paspalum pasture, the daily ration would be somewhat as follows:—

Feeding Stuffs.	Dry Matter.	Digestible Proteins.	Total Digestible Nutrients.	Nutritive Ratio.
	Lb.	Lb.	Lb.	
Chop, 20 lb.	6·4	0·23	4·1	1 to 17
Molasses, 8 lb.	6·0	0·08	4·4	1 to 54
Rank grass, 16 lb.	2·4	0·18	1·6	1 to 8
Total	14·8	0·49	10·1	1 to 20
Minimum requirements	23·4	2·0	16·9	1 to 8

In this instance it is again evident that the animal at hard work is receiving a ration deficient in every detail and demanding an increase in protein-rich feed particularly. Failing this the horse must inevitably lose condition.

MOLASSES AS A FEED.

The preceding example must not be interpreted as a condemnation of molasses as a feed. On the contrary when correctly used it is one of the cheapest concentrates available to the canegrower, but it is to be regarded essentially as an "energy" food, and requires balancing with appropriate amounts of protein-rich concentrates. When used in this manner with the proper proportion of roughage, an excellent ration may be compounded.

In this connection a report recently received from Louisiana lays particular emphasis on that very point. Feeding trials have been conducted in that state over a number of years, with farm mules, and it has been demonstrated clearly that molasses will replace ground maize in a highly satisfactory manner. (It was pointed out earlier that the value of maize lay chiefly in its carbohydrate content, which accounts for the interchangeability of these two feeds.) It was determined that animals could be given up to 9 lb. of molasses daily without apparent detriment to the animal; 6 to 7lb. was, however, considered the most satisfactory allowance. Experience showed that it was best to add the undiluted molasses to the roughage just before feeding.

Typical rations fed to mules in Louisiana plantations are as follows:—

1.	2.
15 lb. ground maize.	7 lb. dried brewers grains.
8 lb. soy-bean hay.	7 lb. cracked maize.
7 lb. molasses.	2 lb. cotton seed meal.
	7 lb. soy bean hay.
	7 lb. molasses.

Soybean hay and cotton-seed meal could be substituted by lucerne hay and linseed meal.

MINERAL NUTRIENTS.

In conclusion, a few comments should be made on the question of the mineral constituents of feed. It is a well recognised fact that an animal must receive its due proportion of minerals—notably phosphate and lime—to maintain it in a healthy condition, and enable it to build the necessary bone and muscle. It is also highly significant that the

pastures of our heavy rainfall areas are markedly deficient in the essential minerals. This is a matter requiring investigation, and in all probability it will be found to be related to the shorter useful life of draught animals in North Queensland.

Several well-established licks supplying the essential minerals are now marketed in Queensland, and their use is well worthy of consideration by farmers in these parts.

Sanctuaries for the Tachinid Fly Parasite of the Beetle Borer.

BY A. F. BELL.

WEATHER conditions greatly favoured the beetle borer during the 1934 season, and this pest was responsible for considerable losses in a number of mill areas. At the same time the weather conditions generally did not favour the Tachinid fly. This parasite was not as effective as it has been in former years, and in many localities was seriously reduced in numbers. With the object of reducing this annual borer loss to its lowest proportions we initiated an intensive Tachinid fly liberation campaign last year, in order to re-establish this fly in areas where the numbers had become depleted for one cause or another, or to establish it in any new areas favourable for the purpose. Once established, and provided that the necessary steps are taken to protect them, the flies carry on the warfare against the borer at no further expense to the farmer. As a result of this big campaign over 10,000 flies were bred and distributed by the entomological staff of the Bureau. The campaign will be continued during the coming season, but to ensure its success it is necesary that growers should appreciate the requirements for the successful establishment of fly colonies in their fields, particularly in the matter of the provision of sanctuaries where they can live unmolested. It must of course be remembered that the fly is sensitive to climatic conditions and cannot be established in all areas where the beetle borer is found. However, flies will be made available to any farmer in those areas where it is considered that the fly will have a reasonable chance of becoming established and in such cases the following points should be observed:—

1. Sanctuaries are required to accommodate the borer grubs and their fly parasites over the summer months, when the young crop is usually small; sanctuaries must consist, therefore, of standover cane, but this cane must still be growing vigorously. In the absence of a sanctuary the adult beetle borer can easily live over until the young crop has made cane, when it deposits its eggs in the cane stalk. The fly cannot attack the adult borer and as it has a short life it will die out under such conditions through lack of borer grubs on which to feed.

2. Sanctuaries should be sufficiently large to support the necessary fly and borer populations. The larger they are the better, but in no case should they be less than a quarter of an acre in extent.

3. There should be a moderate borer infestation of cane stalks in the sanctuary in order to provide hosts, not only for the original flies liberated, but for succeeding generations. Otherwise the flies will migrate to the adjoining fields of young cane and die out. It is useless making liberations where only a small percentage of stalks are bored.

4. Sanctuaries should be located preferably either in a central position on the farm, or on the windward side, so that the flies will migrate over the whole area as soon as the crop is sufficiently far advanced.

5. Sanctuaries should not be located where there is any danger of their being burnt out by encroaching bush fires.

6. As sanctuaries have to function during the drier period of the year they should be established in such a position that good soil moisture is available and continuous growth of the cane is assured. Under such conditions vigorous young suckers are produced throughout the season and these in turn become borer infested, thus providing the fly with a continuous supply of its host. Sanctuaries located on hillsides subject to drying out are almost useless. On the other hand very rank growth should be avoided as the fly cannot operate in lodged or trash-bound cane.

7. Suitable sanctuaries must be permanently maintained after the fly is established in order to enable the flies to persist year after year, and to be available to prevent heavy borer infestation of the remaining fields. It will be appreciated that even under the best conditions the fly never achieves 100 per cent. control, for if it completely destroyed its hosts it must also starve itself out.

Tachinid flies will be available for distribution this year and applications should be made to the Entomologist, Sugar Experiment Station, Gordonvale, but before making an application, farmers should satisfy themselves that the necessary conditions, as set out above, are available. They should also be certain that the fly is not already well established although temporarily somewhat reduced in numbers. There will be many places where last year's weather conditions reduced the flies to such numbers that the borers were enabled to do a good deal of damage, but without reducing the numbers to a point where a further liberation is necessary.

Permits for Transfer of Sugar-cane Plants.

In order to reduce the possibilities of carrying sugar-cane diseases from one district to another in which those particular diseases do not exist, it is necessary that strict precautions be taken in the matter of transferring cane plants from one area to another. In furtherance of this object the State of Queensland has been divided into a number of quarantine districts, and under the provisions of the Diseases in Plants Acts the transport of sugar-cane plants from one such district to any other is prohibited unless a permit has been issued by an inspector under the Acts. The boundaries between these quarantine districts consist of imaginary lines drawn east and west through Cardwell, Townsville, Bowen, Alligator Creek (south of Mackay), Rockhampton, Burrum, the southern end of Great Sandy Island, and Brisbane. Any person desirous of sending cane plants across any of the above boundaries at any time during the current season should make a request for the necessary permit to the Director, Bureau of Sugar Experiment Stations, Brisbane, before 20th July, 1935.

In addition to the above district quarantine areas local quarantine areas are in existence in Maryborough and South Kalkie, and a permit must similarly be requested if it is desired to send plants beyond the boundaries of the quarantine area.

The Giant American Toad *(Bufo marinus)*.

By R. W. MUNGOMERY.

THE Giant American Toad, which, until recent years, was restricted to the tropical and temperate parts of South America and certain of the West Indian Islands, first came forcibly under our notice when Mr. Arthur F. Bell visited Puerto Rico as the official Queensland Government representative at the Fourth Conference of the International Society of Sugar Cane Technologists held in San Juan in 1932. There he was able to see large numbers of these toads successfully operating against the Puerto Rican cane beetle in their newly adopted country, and, of course, the value of such an important predator immediately became apparent. At this Conference Mrs. Dexter presented to the members of this Society a paper detailing the feeding habits of this giant of the toad family. Its diet was found to be both varied and extensive, whilst it possessed an enormous capacity for food. This carefully prepared census of the toads' victims was obtained as a result of the examination of the stomach contents of several hundred specimens which had been captured in various parts of the Island and killed with the above object in view. The examination revealed that of those insects that had been eaten, and whose undigested remains were able to be identified, approximately 51 per cent. were harmful species of insects, 42 per cent. were neutral, i.e., neither harmful nor beneficial, while the remaining small percentage of 7 per cent. proved to be beneficial species.

So impressed were some of the visiting delegates with the possibilities of this animal becoming an important factor in the control of some of the more serious cane pests in their respective countries that they immediately made arrangements to take with them, on their departure, consignments of these toads in order that this useful predator might similarly become established in other parts of the world and continue there its good work.

The toad is a native of tropical America, extending from Mexico to Argentine. From French Guiana it was introduced into Barbados prior to 1850, primarily with the object of preying on young rodents which at that time were inflicting great damage on the cane crops of that Island. It is not reported to what extent they were successful in rat control (possibly of little value), however their effect on insect control was very marked, and from there they have been spread to most of the West Indian Islands, including Puerto Rico in 1920. From Puerto Rico they were taken by Mr. C. E. Pemberton, Entomologist of the Hawaiian Sugar Planters' Experiment Station, to Honolulu, where they rapidly multiplied, and they are now well established in different islands of the Hawaiian group. They have since been sent to the Philippines for colonisation in the canefields.

We, in our turn, have watched with interest the successful establishment of this toad in several new countries, and the gradual suppression of some of the major pests in areas where it has been operating for longer periods, and where its population has reached saturation point. We have also been impressed with the possibilities of such an animal operating against our indigenous cane beetles, and some of our other major sugar-cane pests. The writer's recent visit to Hawaii was made, therefore, primarily with the object of studying the toad in an environment which has proved particularly favourable for its natural spread,

and to bring back sufficient toads to ensure their successful establishment in Queensland. Accordingly, this latest importation of the toad into Queensland will mark another step in the gradual conquest of the warmer regions of the earth by this remarkable animal, and this has been made possible through the courtesy and valued co-operation of the Director and Entomologist of the Experiment Station of the Hawaiian Sugar Planters' Association.

FIG. 8.—A Giant Toad, Half Natural Size.

When full grown, *Bufo marinus* is from 6 to 8 inches in length, and usually from 4 to 5 inches in breadth. The colour varies considerably, but it is usually of an irregular yellowish, reddish, or blackish brown, being darker on the back than on the underside of the body. On each side, just behind the head, they are armed with a conspicuous poison sac. This sac is mainly for defensive purposes, as is evidenced when a dog or other animal picks up a toad in its mouth. The dog soon drops the toad in disgust, curling up its lips, and salivates profusely, as if it had suffered some unpleasant sensation. This experience usually suffices to cure the dog of any further desire to molest a toad.

The skin on the back of the female toad is somewhat warty, but smooth, whilst the males have a much rougher skin, due to several raised tubercles, which give it a feeling somewhat similar to a fine grade of sandpaper. For much of the foregoing and following information the writer is indebted to Mr. Pemberton, who has carried out most of the detailed feeding work in Hawaii, and who also has shown the writer these toads operating in various suitable localities around Honolulu.

No complete life history notes are available concerning the toad's development, owing to the fact that it has not yet been possible to induce this species to breed under confined conditions. However, from observations in Hawaii and Puerto Rico, it is apparent that they lay their eggs practically throughout the whole year when they find suitable conditions, and they mature in about a year. We should therefore expect them to behave similarly in North Queensland, and that eggs would be found most plentifully during the rainy period, November to April, when waterholes generally are full of water.

For their establishment in Hawaii two colonies were liberated, each consisting of from 60 to 70 individuals. One colony was turned loose in the upper reaches of the mountain streams which flow down Manoa Valley, and the remainder were given their freedom in a pond adjacent to a low-lying rice field near Waipio. In both cases they have bred successfully, and can now be found far away from the original points of liberation, whilst they appear to be adaptable to a fairly wide variety of conditions. In the low-lying areas they have multiplied most rapidly, and at the present time young toads are being distributed from Waipio at the rate of 1,000 to 3,000 daily. During last year strings of eggs containing as many as 12,000, which had been laid by one female, were sometimes collected in the waterlogged rice and taro fields, and these were hatched out in a specially constructed pond at the Waipio sub-station by officers of the Sugar Experiment Station. The tadpoles usually hatch out two or three days after the blackish eggs are deposited. They are then about $\frac{2}{5}$ of an inch in length, and they remain congregated together before they separate to feed on the small aquatic plants that are commonly found growing in such situations. It has been found that the tadpoles feed readily on boiled rice, oatmeal, or other finely-ground cereal, and it has been possible to hasten up the tadpole period to three weeks as against the normal period of one month. In their normal rate of development the tadpoles develop a pair of fore-legs towards the end of the first fortnight, whilst some few days before they are ready to leave the water the hind pair of legs make their appearance and the tail is gradually absorbed. When this stage is reached the young toads are still only very tiny—just a little over $\frac{1}{4}$ inch in length—and one would scarcely imagine that they are ultimately to grow into such huge creatures as are now seen in the fields or on the garden lawns around Honolulu.

They feed on ants, small vinegar flies which frequent rotting fruit, and, in fact, on any insect which they are large enough to swallow. One consignment of small toads, which were placed out in a large field of young cane infested with "armyworms," immediately impressed the plantation agriculturists by commencing operations against the young caterpillars, which they snapped up, and though unable to accommodate a whole caterpillar, a young *Bufo* toad would be seen to remain there with portion of the caterpillar protruding from its mouth, apparently unconcerned, but well satisfied that it would ultimately accomplish the task before it. Most of their feeding is done by night, and during the day they can frequently be found hiding in the small holes which surround the banks of irrigation ditches. They grow very rapidly and soon learn to consume different kinds of insects, and there is evidence to show that they regularly visit the same spots at which they have been in the habit of making easy captures of large numbers of insects.

In fact, about the only bad point raised against them is that they sometimes loiter near hives of honey bees and jump up and catch the heavily laden bees returning to the hives, but this can easily be remedied by raising the hives to a height of 2 feet or more from the ground, or by surrounding the hives with small mesh wire netting. As most of the bee-hives in Queensland are usually placed more than 2 feet above the ground this introduction of *Bufo* should not prove any serious hardship to Queensland beekeepers.

Their normal diet consists of all kinds of beetles, cockroaches, mole-crickets, weevils, caterpillars, centipedes, sowbugs, and the like, and the toad will usually snap at any moving object that attracts its attention. It is an amusing sight to watch a toad snap at a centipede, and with one-half of the creature down its throat and the other half protruding from its mouth the toad quickly uses its forelegs to assist in pushing the remainder of the centipede effectively out of view down its huge throat. Centipedes apparently have no ill effects on the toad, neither does the "Black Widow" spider, a very venomous species which was recently fed to a toad, and which produced no harmful effects whatever on the toad that consumed it.

Certain individuals have raised the question of the toads possibly proving a nuisance owing to the noise they will make. Their call is not objectionable, and certainly not as loud nor as shrill as that of many species of frogs which are indigenous to Australia. It has sometimes been described as being similar to the distant sound of a motor cycle, of that regularity, but more musical. The writer can best describe it as being similar to the latter part of the call of the brown pheasant-coucal, which is commonly found in most Queensland canefields.

To others who scent a "nigger in the woodpile" and suggest the possibility that the toad will, in turn, itself become a pest, we can point to the fact that nearly 100 years have elapsed since it was first introduced into Barbados, and there it has no black marks against its character. Experience with it in other West Indian Islands, and in Hawaii, certainly points to the fact that no serious harm is likely to eventuate through its introduction into Queensland.

We, however, wish to raise one important note of warning. This toad, though large, is not the edible species of frog, **and it must not be eaten.** The glands at the side of its head secrete a digitalis-like poison, adrenalin, and other more obscure poisons, and if the toad is eaten the net effect of these poisons is apt to have a very serious effect on the heart. Whilst the writer was in Hawaii a young Filipino child died, and it was alleged that she died as a result of her parents giving her a portion of a toad to eat. Whether these facts are true or not is difficult to ascertain, but this example should be sufficient warning to deter anyone so minded towards a dish of the famous French delicacy to defer it until the edible variety of frog is available, and certainly to give *Bufo* a wide berth.

From Manoa Valley the toads have spread of their own accord down to the city of Honolulu, and at night many individuals from small to nearly full-grown can be seen on the lawns in the residential section, whilst at other times an unfortunate toad can be found dead on the road, having been run over by a passing motor car. At Waipio dozens of smallers ones can be seen hopping along the edges of the irrigation reservoirs, whilst in shallow shady ponds, where hyacinth and taro are growing, as many as twelve nearly full-grown specimens can be counted

hanging around the base of one taro clump. Other taro plants similarly harbour a large number of toads at their bases, and when it is remembered that up to 3,000 toads are daily distributed from this centre it will be apparent to what extent these animals have multiplied during the three years since they were first liberated in these localities. Pools of water are necessary only for the egg and tadpole stages, and once the young toads have forsaken the waterholes they are able to grow up and flourish without having regular access to water. This is evidenced from the fact that toads are often found far distant from any streams or ponds.

The toad has proved a very popular introduction into Hawaii, both amongst the sugar-cane plantation managers and amongst the resident population of Honolulu, and requests are ever forthcoming from them for liberations of toads to be made on their respective properties. Many of the garden owners are loud in their praises of the good work which the toads are doing, and they report a decided decrease in the incidence of many kinds of pests this year. Many garden plants, such as roses, cannas, lettuce, &c., which were severely damaged by the small Asiatic beetle, now show very little injury in places where toads are common. Although it is unwise to draw conclusions too hurriedly as to the benefits resulting from the introduction of *Bufo marinus*, as weather conditions are known to have far-reaching influences on pest activity, still, from these persistent favourable reports that are being received, it seems highly probable that this American toad has contributed in some measure towards this noticeable reduction in some of these major pests.

The *Anomola* cane beetle is so well controlled at the present time by several parasites and predators that cane grub damage was non-existent during the period of the writer's visit to Hawaii; but at the same time, if the trouble ever did become serious again, it is probable that owing to the secluded habits of the beetles prior to and during oviposition, the toad would have little chance of locating and eating them before they had time to lay their eggs. They could, therefore, not be expected to clean up every small outbreak of *Anomola* which might occur periodically in future years. However, as a very excellent parasite and predator complex, supplemented by arsenic treatment of infested soils, appears to be taking care of all *Anomola* grub infestations, Bufo may not be needed to assist greatly in this work.

In Puerto Rico the Giant Toad, through its attack on the local cane beetle (slightly smaller than our Greyback cane beetle) has been signally successful in cleaning up white grub damage, and if its introduction into Queensland is followed by a control of the magnitude of that obtained in Puerto Rico, then something very tangible in white grub control will have been attained as a result of this importation. Concerning the status of the Puerto Rican white grub, and the influence of the Giant Toad, Wolcott has the following to say:—

"In less than ten years after its first importation into Puerto Rico the Giant Toad, *Bufo marinus* L., has changed the economic status of white grubs on the island from that of a major pest to one of comparative rarity. The most obvious indication of such a change is that fields of sugar-cane on the South Coast, especially in districts where grubs were formerly most abundant, can now be successfully and profitably ratooned. When white grubs were abundant such a procedure would

have been impossible; now it is the rule. Formerly the roots of sugar-cane were so completely destroyed that the stalks had to be harvested in advance of normal maturity, now they are so numerous that ploughing and replanting are obviously unnecessary. To be sure, different varieties of cane are being grown, and some other factors have been changed, but the one of importance is that white grubs are no longer present in sufficient numbers to cause appreciable injury to the cane roots. For this changed condition the imported toad is almost entirely responsible."

Parts of North Queensland are particularly well favoured with mountain streams intersecting or flowing near to canefields, whilst other parts are flatter and more swampy, and provide conditions which are comparable to either the Manoa Valley or Waipio types of country in Hawaii, so that conditions should prove suitable for the establishment of this toad which has hitherto proved so adaptable to rapid multiplication under conditions obtaining in most sugar-cane growing countries.

The Greyback cane beetles, against which this toad has been primarily introduced, fly to various feeding trees soon after their emergence from the soil, and a period of approximately 14 days elapses before their eggs are sufficiently developed to be deposited in the soil. During this 14-day period the beetles alternate between the feeding trees and resting trees, but the toads do not ascend trees, so that they are not likely to exact toll from them in these positions. From information gleaned elsewhere it appears that in Puerto Rico a somewhat similar state of affairs exists, where the beetles fly nightly to feed on such trees as poincianas, casuarinas, bananas, pigeon peas, and occasionally on sugar-cane itself, returning to the soil in the early morning, and it is probable that the toads account for large numbers of beetles either when they are emerging from or returning to the soil. It would appear, therefore, that such habits are ideal from the point of view of control of the beetle by the toad, for the fact remains that these animals ultimately account for large numbers of beetles.

With regard to the Greyback beetle, the same clear cut daily return of the whole beetle population to the soil does not exist. Therefore, the degree of control which we can expect through the agency of these toads will centre largely around the length of time the beetles actually spend on or near the ground either when they are emerging from or re-entering the soil, and of course around the number of times they subject themselves to this procedure of migration from soil to feeding trees and vice versa. Therefore, in direct proportion to the length of time spent by the Greyback, or any other beetle pest, on or near the ground in accessible places (or, rather, in places usually frequented by the toads), so might we expect the degree of control of these pests to rise proportionately high. There seems to be little room to doubt that when these toads have reached saturation point they will greedily devour any beetles of a similar size that may come within their sphere of activities.

Wolcott, who apparently was under the impression that *Bufo marinus* had already been imported into Queensland and Fiji, has the following to say concerning these introductions in a paper read before the Association of Sugar Cane Technologists of Puerto Rico, December, 1934:—

"If conditions in these countries are at all comparable to those in Puerto Rico, let me now predict that within ten or fifteen years the white grub problems of these countries will be solved."

Whilst all of our species of white grubs may not lend themselves to control by the Giant Toad, and we may not altogether entertain the same high degree of optimism as that displayed by Wolcott, still we have reason to maintain a certain amount of optimism concerning the effect that this toad is likely to have in minimising Greyback grub damage in some of our Northern canfields. Whether our speculations are fully justified is one of the fascinating problems met with in economic entomology, and time alone will show whether our cherished hopes for the total elimination of grub damage in Queensland canefields will be realised.

A New Quarantine House.

By A. F. BELL.

ON this page we reproduce a photograph of a new insect-proof glass house which has been constructed in Brisbane for the reception of new cane varieties imported by the Bureau from overseas. This house has been designed in accordance with modern quarantine requirements and will be put into commission during July-August, when five new varieties will be received.

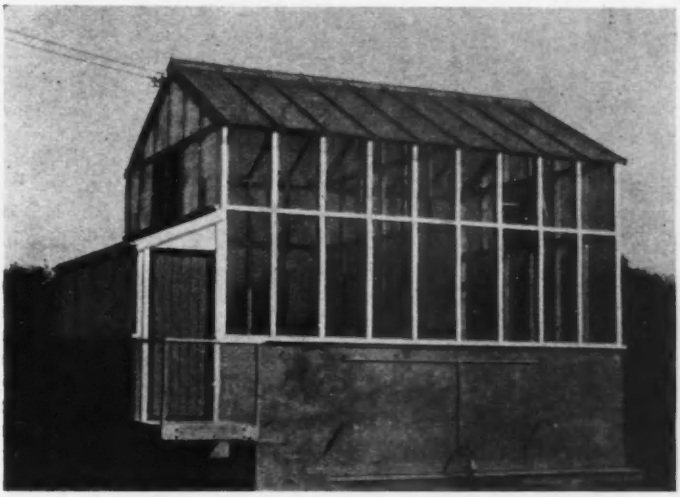

FIG. 9.—Quarantine House recently completed in Brisbane.

The structure is of reinforced concrete, with the superstructure composed of glass, which is reinforced for protection against hail-storm damage. Ventilation is provided by panels in which copper gauze is substituted for glass; on the far side of the house, and at either end, the gauze is set within hinged glass doors so that the draught can be regulated. In summer, to prevent excessive temperatures, canvas blinds can be drawn across the underside of the roof. Entrance is gained through a double closed compartment, one half of which is painted black inside and is completely dark when closed. The object of this is to reduce the probability of insects flying into or from the house when a person is

passing in or out. The floor of the house is some four feet above ground level and is reached by steps which do not make contact with the main structure, thus preventing the ingress of ants. In addition, the main structure is surrounded by a gutter, let into the concrete, which is filled with water; sticks and leaves which would act as rafts for ants are kept out by a small sheet iron awning.

The interior of the house is divided into two sections, the larger of which will carry six stools of cane and the smaller four stools. The cane is grown in sections of concrete piping 2 ft. in diameter and 2 ft. 6 in. high, and can be grown to maturity without difficulty. The soil in which the setts are planted is sterilized before being placed in the tubs.

Upon being received from overseas the material in which the cane has been packed is destroyed, and the cane is sterilized in corrosive sublimate to kill any fungus spores which may be attached to the surface. The setts are then treated in warm water at 125 degrees Fahrenheit for a period of 20 minutes before being planted; the value of the warm water treatment is three-fold; it stimulates germination of the setts, it cures certain diseases, and it destroys insect eggs which may have been deposited in the cane.

For the purpose of the despatch of cane setts from one country to another they are packed in powdered charcoal to which has been added about 10 per cent. of water, plus a little formalin, to prevent the growth of moulds. This amount of moisture is sufficient to prevent the setts from drying out when placed in a sealed container, but is not sufficient to encourage germination. As a further protection the freshly cut ends of the setts are pitched before packing.

It is at times argued that, since Queensland is cursed with the presence of nearly all the important diseases of sugar cane, elaborate precautions are unnecessary when introducing new varieties. However, modern investigation has shown that this is a fallacious argument because in very many diseases there exist so-called "strains" of the "germs" which cause the disease. For example, there are at least a couple of dozen strains of the fungus which causes wheat rust and a particular variety of wheat may be susceptible to only three or four of these strains. As only a fraction of these strains are usually present in any one locality it will be seen that a variety which is considered to be resistant to rust in one area might prove very susceptible to a strain present in another area. In the case of the well-known mosaic disease of sugar-cane it has recently been found that there are at least three strains of this disease present in the United States. Furthermore, varieties which are resistant to one strain have been found to be susceptible to one or both of the others. Very probably we do not have these three strains in Queensland, therefore, it will be appreciated that although they have mosaic disease in the United States, and we have mosaic disease in this State, it may not be quite the same; and careless handling of imported setts may introduce a mosaic disease which would attack our most important varieties. It is obvious therefore that great care will always have to be exercised in the importation of new varieties and a quarantine house such as the one illustrated will greatly assist us in maintaining adequate safeguards.

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